grounds, resulting in the gradual elimination of the trees and thickets which provide natural cover and protection for the deer. This issue has been raised with the central government, and the Department of Game and Wildlife is considering the feasibility of designating the area a regional park. Some uncertainty has also been caused by a claim made by the neighbouring Gomoa on a section of Tuafo company's hunting ground. Even if this claim is upheld, however, it is unlikely to create a situation which would place the festival in jeopardy. Had the Aboakyer remained an exclusive, local affair instead of becoming a major visitor attraction, these kinds of problems might well have signalled its demise.

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Place-Names, Population Density, and the Magic Number 500[1]

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Recent research on the relationship between toponymic density—the number of named places per square mile within the range of a linguistic community—and the population density of that community has revealed a significant correlation between the two variables. Toponymic density is an instance of the more general concept of lexical density—the ratio of the number of named elements within a semantic domain or subdomain to the size of the referential space spanned by the terminological set. For example, we might measure the lexical density of a plant domain for a particular speech community by calculating the number of basic plant categories named—Berlin's (1992) folk generics—and dividing that total by the number of plant species attributed by Western botanists to the area occupied by members of that community. Such a statistic provides a basis for explicit and meaningful cross-cultural comparisons. Likewise, color-term densities may be compared by reference to a "semantic space" defined by the Munsell color chart (Berlin and Kay 1969) and kin-term densities compared by reference to a genealogical grid measured along descent lines (Atkins 1973). Calculating the density of terms for snow, as in the notorious Boasian example (Martin 1986), awaits a systematic definition of an etic climatological space.

The calculation of toponymic densities, while straightforward in principle, is difficult and problematical in practice. A reliable calculation requires (*a*) a systematically elicited, comprehensive inventory of place-names in use within a defined speech community. This in turn presumes that a "place-name" is a culturally meaningful notion for native speakers and that place-names may be reliably distinguished from nonce forms, descriptive constructions, and "topographic generics" such as "river," "hill," or "lake" and (*b*) that the geographical locations of the places named may be specified and that those locations fall within a bounded area occupied and utilized by and thus familiar to members of the speech community. It is also necessary to distinguish polysemous and homonymous usages, to discount synonymous terms, and to decide whether to count terms recently adopted from other languages.

The calculation of population densities is a more familiar procedure but not without its own ambiguities. This statistic should closely reflect the actual number of people who make a living from a given tract of land. Thus the densities of communities highly dependent on regional or global markets may not be comparable for present purposes. In contact situations indigenous populations may fluctuate drastically because of heightened mortality, dislocation, altered modes of production, and new medical technologies. The most appropriate population figures are those characteristic of the community during a time period in which the traditional place-name set was in active use. Population figures representing such a time period must often be estimated by extrapolation from later census data (Boyd 1985). Sometimes it is necessary to use population density figures for a region wider than the one to which the place-name data apply. However, these imperfections in the available data should not systematically bias the results of a comparative study like this one.

The following 12 cases, which represent a sample of convenience but exhibit a substantial range of linguistic, geographic, and economic features, were examined:

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1. The Sahaptins, an interior riverine people, dependent on gathering, fishing, and hunting, of the Columbia Plateau at ca. 46° N. A total of some 1,043 named places recorded between 1853 and 1993 applies to a contiguous area of 43,417 square miles, yielding a toponymic density of 0.0240. It is clear, however, that there has been considerable attrition of geographic knowledge since Lewis and Clark first traversed the region in 1805. A more accurate sense of the density of place-names prior to the disruptions caused by Euro-American occupation is gained from a "geographic text" recorded in 1927 from an elderly Sahaptin-speaking man, Jim Yoke (Jacobs 1934–37). Yoke recounts the travels of Coyote in the Myth Age, in the course of which Coyote names 273 sites. These names represent an indeterminate but substantial fraction of Yoke's total toponymic vocabulary. His account ranges over nearly 7,000 square miles, though a core area of 4,400 square miles in which 265 named sites are located represents the area with which he was personally familiar. The density of names within Yoke's "home range" is thus 0.060. Extrapolating this density to the entire Sahaptin range leads one to conclude that the documented corpus of Sahaptin place-names represents less than 40% of the likely precontact figure. Precontact Sahaptin population density has been estimated at 0.74 persons per square mile (Hunn 1990:135).

2. The Upper Inlet Dena'ina (the largest of four dialect groups of Dena'ina Athabaskan-speakers of south-central Alaska), a coastal and riverine people, primarily dependent on fishing and hunting, at ca. 62° N. Kari and Fall (1987) map 711 Dena'ina named places within a traditional use area of 26,500 square miles for a toponymic density of 0.027. Shem Pete—a primary source for these names and perhaps an exceptional individual in regard to his geographic expertise—could recall 634 from memory and had traveled over more than 13,000 square miles of this territory during his lifetime. The precontact Dena'ina population has been estimated at 5,000 in a total area of 46,250 square miles for a density estimate of 0.108 persons per square mile.

3. The Kantishna River Athabaskans, occupying a tributary of the Yukon River just north of the Dena'ina at ca. 64° N and like their neighbors dependent on fishing and hunting for the bulk of their food supply. Within the 6,770 square miles of this drainage 175 (predominantly Koyokun) Athabaskan names have been recorded (Gudgel-Holmes 1989) for a toponymic density of 0.026 per square mile. This is likely less than the precontact density. Population density at contact has been estimated at 0.015 persons per square mile.[2]

4. The Inujjuamiut, arctic hunters and fishers located on the east coast of Hudson's Bay at ca. 58° N. Müller-Wille (1991) reports 736 place-names within 5,212 square miles (60% sea, 40% land) for a toponymic density of 0.141. Though the population of the village was 580 in 1977 it is estimated to have been just 150–280 before contact (E. A. Smith, personal communication, 1993) for an estimated contact-period population density of approximately 0.041.

5. The Kwakiutl, a coastal people of British Columbia at ca. 51° N primarily dependent on hunting, fishing, and gathering of marine resources. Boas (1934) mapped 2,323 Kwakiutl place-names within 10,467 square miles for a toponymic density of 0.222. A precontact population of 8,000 has been estimated within a total territory of 13,019 square miles for a population density of 0.614 per square mile.

6. The Quileute, a north-temperate coastal group of the Washington coast at ca. 48° N with an aboriginal subsistence economy very similar to that of the Kwakiutl. Powell and Jensen (1976) record 118 named places within a range of ca. 1,740 square miles for a toponymic density of 0.068.[3] The 1889 population of the Quileute was 323 for a density of 0.186. Both of these figures are minimal estimates following over a century of Euro-American contact.

7. The Yurok, occupying the lower Klamath River and a stretch of coastline south from the mouth of the Klamath in northern California at ca. 41.5° N and dependent on hunting, fishing, and gathering. Waterman (1920) mapped 943 place-names within a well-defined Yurok territory of 672 square miles for a toponymic density of 1.40.[4] The earliest population estimate for the Yurok is 3,100, giving a density of 4.61 persons per square mile.

8. The Tewa, six Pueblo farming communities in the upper Rio Grande Valley in north-central New Mexico at ca. 36° N. Harrington (1916) mapped 1,534 Tewa place-names within an area of 6,747 square miles for a toponymic density of 0.227 per square mile.[5] The early-contact-period population of these six pueblos is estimated at 2,100,[6] which gives a density of 0.311 for the area mapped. Harrington suggests that the people of each pueblo were intimately familiar with places within their areas of occupation but often unfamiliar with places named within the territories of other Tewa-speaking pueblos. This suggests that a typical individual

2. I have added 30% to the 1843 estimate cited in the *Handbook of North American Indians: Subarctic* to compensate for an 1839 smallpox epidemic.

3. Powell and Jensen cite 137 Quileute place-names, but 19 are for places north of the Quileute range delimited in the *Handbook of North American Indians: Northwest Coast.*

4. Waterman believed that the place-names he had recorded represented only one-third to one-fourth of the total in use. If so, the toponymic density would have been 4.2 to 5.4 per square mile. However, Waterman also claimed to have recorded "thousands" of place-names when in fact the total is just 943. The Yurok area is rather sharply delimited. I take the boundaries from the *Handbook of North American Indians: California.*

5. I exclude 61 named places in one large area south of the core Tewa range, the area covered by Harrington's map 29. If these place-names are included and the area of that map added to the Tewa range for calculating both toponymic and population densities, the respective figures are 0.115 and 0.151. This has little or no effect on the ratio of the two densities.

6. Based on figures reported in the *Handbook of North American Indians: Southwest.* These pueblos now control or claim just 285 square miles.

Tewa-speaker might have known somewhat more than one-sixth of the total Tewa inventory or somewhat more than 300 place-names.

9. The Western Apache community of Cibecue, Arizona, at 34° N depends in roughly equal measures on gathering, hunting, and farming. Basso (1984 and personal communication) has recorded some 506 place-names within a 133-square-mile region that had a population of 875 in 1959. These numbers give a toponymic density of 3.80 and a population density of 6.58 per square mile. The typical individual inventory would be close to 500 because Cibecue is a single community.

10. The Zinacantan Tzotzil, farmers of a tropical highland region of Mexico at ca. 17° N. Laughlin (1975) mapped 1,063 named places in the municipio of Zinacantan,[7] and Vogt (1970) gives the population in 1970 as "more than 8,000" within 45 square miles. This gives a toponymic density of 23.6 and a population density of 175 per square mile. Individual Zinacantecos are unlikely to be familiar with more than half of the places mapped, since the more salient unit for daily life is the *paraje* or hamlet, with a population of 121–1,227. My experience in Tenejapa, a Tzeltal Mayan community quite comparable to Zinacantan, suggests that individuals are likely to be personally familiar only with that portion of the municipio where the family has land and through which they habitually travel to market.

11. Tonga, occupying a Pacific island group at ca. 20° S and dependent on agriculture and fishing. Gifford (1923) published an inventory of 4,776 Tongan place-names in use to refer to 8,200 distinct named places (including homonymous usages). The total area of the island group including interior lagoons is 270 square miles, and the population in 1921 was 24,000. Thus the toponymic density and population density ca. 1920 were 30.4 and 88.9 per square mile respectively.

12. The Andyamathanha, an Aboriginal group located in an interior-desert mountain region of South Australia at ca. 31.5° S and dependent on gathering and hunting. Tunbridge (1988) has recorded 227 named places from a series of "dreamtime" stories set within 17,364 square miles of their traditional range for a toponymic density of 0.013. The actual value would be somewhat higher, as sacred sites were not reported and places were limited to those named in the stories. Radcliffe-Brown estimated the precontact population density of South Australian desert regions at 0.0125 per square mile (Long 1971).

The coefficient of linear correlation (Pearson's r) for the logarithms of toponymic density and population density for these 12 cases is 0.95 (see fig. 1), with 90% of the variance in toponymic densities attributable to the influence of population density. This result is statistically significant: $t = 9.42$, $p \ll 0.001$ (d.f. = 10).

The substantial range of variation in population densities represented by these 12 cases reflects the striking contrasts in density characteristic of foraging as opposed to agricultural economies. The sample also represents a wide range of natural habitats, from tundra and desert to Pacific islands and fertile tropical highland at latitudes ranging from 64° to 17° north or south of the equator. All represent economic systems in which local resources sustain the great majority of local consumption needs. Such subsistence economies depend on a detailed knowledge of the local environment. If place-name systems may be seen as an index of the level of "cognitive resolution" of the landscape characteristic of particular cultures, these results indicate that cognitive resolution is highly sensitive to population density. Why should that be? I believe that there is a straightforward answer: that the relationship between population density and toponymic density is mediated by individual memory, in particular by an information-processing limitation that I will call the magic number 500.

It has been noted that folk taxonomies of plants and animals typically include approximately 500 basic-level named categories (Brown 1984, 1985). Berlin refers to this regularity as "Nature's Fortune 500" (Berlin 1922: 96–101), citing Lévi-Strauss as the first scholar to recognize it. In *The Savage Mind* Lévi-Strauss (1966:153–54) observed that, "in . . . ethnozoological and ethnobotanical works, . . . with rare exception, the species and varieties recorded seem to be in the order of several hundred, around three hundred to six hundred." He surmises that this might reflect "a sort of threshold corresponding roughly to the capacity of memory and power of definition of ethnozoologies or ethnobotanies reliant on oral tradition." Berlin finds that the total reported numbers of folk generic taxa for 24 ethnobotanical systems that have been "relatively completely described" range from 137 to 956 (152 to 689, if we exclude the two extreme cases) (p. 98). Similarly, 10 well-described ethnozoological systems have from 186 to 606 folk generics each (p. 100). The range of variation within each set appears to reflect, among other things, the type of subsistence economy, the degree of local biological diversity, and the degree of acculturative loss the culture has sustained.

Place-name inventories, by contrast, may, as we have seen, run to thousands of terms. There is, however, a key difference between this domain and the ethnobiological ones. Whereas in the ethnobiological cases the named categories represent the whole domain defined from the perspective of an "omniscient informant" (Werner 1969) and the shared fraction of the inventory may approach 90% (Hays 1974), knowledge of named places is highly localized, no single individual knowing more than a fraction of the named places in the lexicon of the geographically extended language group. This follows from the fact that plant and animal names are common nouns referring to species that are widely distributed while place-names are proper nouns referring to unique points or regions.

What little evidence we now have suggests that individual place-name repertoires closely approximate 500 (table 1), and I suggest that this may explain the correlation in the data between toponymic and population densities: As population density increases, there is a corre-

7. Laughlin also maps 200+ additional named sites outside the municipio where market-oriented farming on leased land has recently become important.

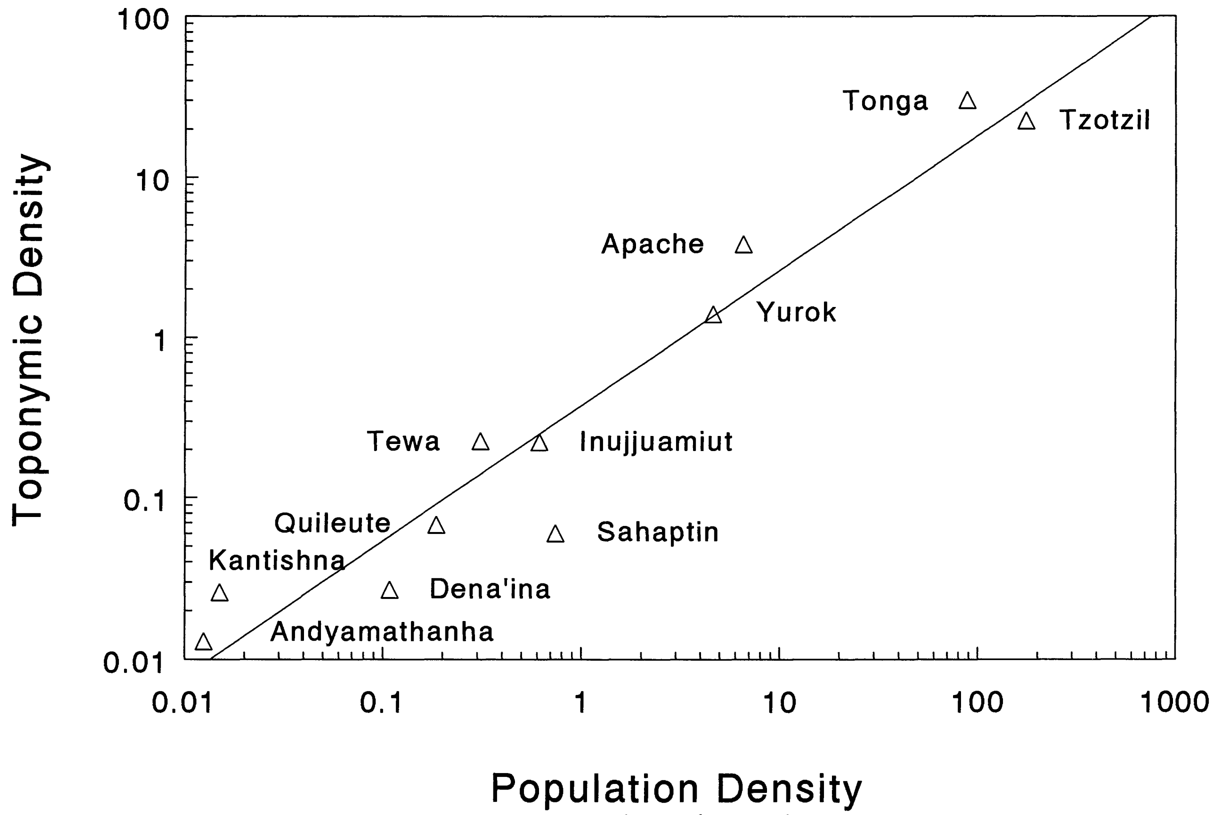

FIG. 1. *Toponymic and population density.*

sponding contraction of the territory with which a given individual is intimately familiar. Whereas Shem Pete covered 13,000 square miles of Upper Inlet Dena'ina territory and Jim Yoke was personally familiar with over 4,400 square miles, the entire Yurok territory was just 643 square miles and a Tenejapa farmer may feel uncomfortably out of place even in the more distant hamlets of his own community, which measures less than 50 square miles. If an Athabaskan holds in mind approximately the same number of place-names as a Zinacantan farmer but applies that set of names to the features of a territory nearly 1,000 times larger, the inevitable result is a lower density of place-names.

TABLE I
Toponymic and Population Density for 12 Communities

	Toponyms			
	Total	Individual	Density	Population Density
Sahaptin	≥1,073	>279	0.060	0.74
Dena'ina	711	~600	0.027	0.108
Kantishna	>175	≥175	0.026	0.015
Inujjuamiut	736	<736	0.141	0.041
Kwakiutl	2,323	n.a.	0.222	0.614
Quileute	>118	≥137	0.068	0.186
Yurok	≥943	<943	1.40	4.61
Tewa	1,534	>300	0.227	0.311
Apache	506	<500	3.80	6.58
Tzotzil	1,043	<500	23.6	178.0
Tonga	8,200	n.a.	30.4	88.9
Andyamathanha	>227	>227	0.013	0.0125

The magic number 500 has also been posited as the modal size of a basic socio-demographic unit among foraging peoples that Birdsell (1953, 1958) called the "dialectical tribe." Birdsell argued that this was a "self-defining unit based upon the density of face-to-face communications" whose boundaries "in pre-contact times clearly acted as a partial barrier to cultural exchanges" (1970:125). He believed that this unit had important social, demographic, and genetic implications for human evolution. I would like to speculate further that the size of such units—500 with a normal range of 200–800—might be understood in terms of the same cognitive limitation suggested by the ethnobiological and toponymic data. If social relationships within this "tribe" are personal while those with individuals beyond the tribal pale are impersonal or stereotyped, a limit of 500 might be reasonable given the amount of information an individual must remember to maintain them. It is well known that members of hunting-gathering societies keep meticulous accounts of the "balance of payments"—the give-and-take involved in food sharing and gift exchange. Evolutionary theorists have argued that systems of "reciprocal altruism" require effective personal accounting to escape the disruptive manipulations of "cheaters" (Trivers 1971). In short, networks larger than 500 individuals may be cognitively unmanageable.

There is no obvious cognitive psychological explanation privileging the number 500 as a memory limitation. In fact, human memory is considered by cognitive psychologists to be for all practical purposes limitless (E. F. Loftus, personal communication, 1993). However, special demands on memory are posed by oral traditions (Goody 1977). Perhaps human memory is like a bookcase each shelf of which is capable of holding only a certain number of basic units of information.

In sum, the strong positive correlation demonstrated here between population density and toponymic density may be understood as the consequence of a domain size-limitation imposed by the constraints of individual human memory. This cognitive constraint could interact with demographic and economic factors in cultural evolution to produce the observed result. Whether this pattern holds in modern urban, global-market-dominated contexts requires study. The possibility that a common cognitive factor may affect the organization of folk-biological, geographic, and social knowledge is at least surprising, and it directs our attention to a process that may affect the way in which humans understand and adapt to the physical, biological, and social realities that constitute the human environment.

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Theorizing Sexuality: Seeds of a Transdisciplinary Paradigm Shift[1]

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The topic of human sexuality remains conceptually undeveloped. In anthropology, in particular, sexuality is typically ascribed the status of illegitimate child in the study of marriage, reproduction, and kinship relations (Frayser 1993, Tuzin 1991). Perhaps this is not surprising. There are many pressures and obstacles facing seri-